Underground Storm Water Detention & Retention Systems
Underground storm water detention and retention systems are popular items in construction sites for many reasons, some of which are as follows:

- May enable smaller sizes of mainline pipe.
- Possible utilization of existing drainage when developing new areas.
- The surface area made available due to underground storage can be utilized as valuable, developable land.
- Less liability – less insurance – than storm water management ponds.
- Less maintenance costs than maintenance costs for storm water management ponds.
- Environmental benefits from the storage of storm water that can later be discharged into the municipal system at a controlled rate.
- In dry areas, water can be stored for times of need.

Many companies have attempted to capitalize on the need for storm water storage and use with new products and new configurations. None of these products has proven to be a good substitute for the tried and true precast concrete pipe and box sections. Regardless of the necessary volume, the structural strength requirements, or the need for special fittings, precast concrete is the solution.

One of the materials that has been promoted for storage systems is HDPE – pipe and chambers. The historical performance of these products has not been good. Although the initial and replacement costs may be transparent, the litigation costs, which usually are not revealed, also may be very large. Following are examples of their poor performance.

An elementary school parking lot collapsed over an HDPE pipe detention system in Columbia, SC. The School Board spent valuable funds on a replacement system consisting of 2,000 feet of 48” diameter precast reinforced concrete pipe.

There have been three reported HDPE bundled pipe and chamber detention system failures in Illinois. In each case the HDPE material collapsed and consequently the parking lots collapsed. At least one of these systems was replaced with precast concrete box sections.

An HDPE detention system failed at Ft. Bragg, NC before the entire project was finished. The volume of the system was 65,000 cu.ft. It was replaced with concrete pipe.

In a business park near Valrico, FL a header section of a very large 60” diameter HDPE detention system was severely deflected and had to be replaced. It was revealed that the project specifica-
tions, which required using a Class I or Class II backfill material for a fully encapsulated backfill envelope, were not followed. Instead, a Class I stone material was placed up to the springline and in situ material was used for the balance of the backfill. This failure, which occurred early in the project, delayed the work to complete the parking lot and begin construction of the buildings in the office park.

A large detention system consisting of HDPE chambers in a suburban mall in Massachusetts failed approximately ninety days after installation. The forensic analysis performed after the failure revealed the detailed project plans and product drawings and the fact that the product was installed according to plans. The conclusion was that the product just simply was not strong enough for the application.

So why should a designer consider using precast concrete products for underground detention and retention. The many attributes of reinforced concrete pipe (RCP) and precast concrete box sections become clear when these products are considered for underground detention and retention systems. Following are benefits of using concrete pipe and/or precast concrete boxes:

- **Ease of Design** - Precast concrete products can be designed for any site condition. Designers are more familiar with and have more design knowledge of concrete than any other product.
- **Size and Shape Options** – RCP and precast concrete boxes provide the designer with a large range of shapes and sizes.
- **Footprint Efficiency** - The use of precast concrete products allows large volumes of water to be handled in a relatively small footprint.
- **System Cost** – Efficient footprint and shallow installation due to brute strength allow for a cost effective water storage system (reduced excavation, reduced select backfill, less compaction/installation time when compared to flexible systems).
- **Construction Time Reduction**- precast systems allow quick installations and immediate backfilling so overall site work can progress on or ahead of schedule.
- **Water Quality** - Precast concrete storage systems can be used in conjunction with structural storm water quality units. The systems can contain or be designed to provide storm water quality treatment incorporated into the precast system.
- **Service Life** - Whatever precast concrete product is selected, the owner can rest assured of a structurally designed system that will outlast all other products at a competitive cost.
- **System Access, Inspection, Maintenance** – Precast systems can be designed for inspection and maintenance access. The flat bottom of precast box sections provides for easier and more efficient cleaning/maintenance.

When considering an underground detention or retention system, contact a member of the American Concrete Pipe Association to discuss the best and most cost effective precast solution for your project.
### Project Examples – Footprint (Capacity) Comparisons

#### Example 1:

**Value Engineering of Storm Water Management Systems**

<table>
<thead>
<tr>
<th>Project Requirements:</th>
<th>System #1</th>
<th>Option #1 (Flexible)</th>
<th>Option #2 (RIGID)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Storage Volume Required:</td>
<td>24,535 CF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Option #1 (Flexible)**

- 60 inches Diameter of Pipe
- 1250 LF Length of Pipe required
- 19.625 SF Area of Pipe / LF
- 24 inches Minimum Cover Limits for H2O Live Load

**Option #2 (RIGID)**

- 8 FT Width of Precast Concrete Box Sections
- 8 FT Height of Precast Concrete Box Sections
- 396 LF Length of Box required
- 62 SF Area of Box / LF
- 0 inches Minimum Cover Limits for H2O Live Load

<table>
<thead>
<tr>
<th>Total Storage Volume</th>
<th>24,531 cubic feet</th>
<th>24,535 cubic feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>625 FT Length - excavation required</td>
<td>396 FT Length - excavation required</td>
<td></td>
</tr>
<tr>
<td>15 FT Width - excavation required</td>
<td>9.33 FT Width - excavation required</td>
<td></td>
</tr>
<tr>
<td>7.5 FT Depth - excavation required</td>
<td>9.33 FT Depth - excavation required</td>
<td></td>
</tr>
<tr>
<td>1,696 CY Select Backfill (stone) Required less bedding</td>
<td>365 CY Select Backfill (stone) Required less bedding</td>
<td></td>
</tr>
<tr>
<td>174 CY Bedding Required</td>
<td>68 CY Bedding Required</td>
<td></td>
</tr>
<tr>
<td>9,375 SF Footprint of system</td>
<td>3,693 SF Footprint of system</td>
<td></td>
</tr>
<tr>
<td>2,604 CY Total excavation</td>
<td>1,277 CY Total excavation</td>
<td></td>
</tr>
</tbody>
</table>

**Comparison of excavation:**

- Option #2 has 51.0% less of excavation than Option #1.
- Option #2’s footprint is 60.60% less than that of Option #1’s.
- With Option #1 there is 1,696 CY more stone required for backfill than with Option #2.

**Comparison of estimated costs:**

<table>
<thead>
<tr>
<th>$ / FT</th>
<th>Diameter of pipe</th>
<th>$ / CY</th>
<th>Excavation Costs - standard not rock</th>
<th>$ / CY</th>
<th>Select Backfill Costs</th>
<th>$ / CY</th>
<th>Fabrication Costs (Fittings/bends/ect.)</th>
<th>$ / CY</th>
<th>Excavation Costs for Footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ / FT</td>
<td>Precast Concrete Box Sections</td>
<td>$ / CY</td>
<td>Excavation Costs - standard not rock</td>
<td>$ / CY</td>
<td>Select Backfill Costs</td>
<td>$ / CY</td>
<td>Fabrication Costs (Fittings/bends/ect.)</td>
<td>$ / CY</td>
<td>Excavation Costs for Footprint</td>
</tr>
</tbody>
</table>

| $ - | Total estimate for pipe system | $ - | Total estimate for Precast Box Sections system |

#### Example 2:

**Project breakdown:**

- Storage requirements – 135,000 cf
- 2 alternate designs, CMP or precast box sections
- 10’ diameter CMP – 78.5 sf/foot
- 10’x10’ box sections – 98.0 sf/foot

**Precast Box Sections Advantages:**

- A box system has 20% volume advantage per linear foot
- 1,736’ of CMP 10 barrel w/ header pipe
- 1,378’ of box 11 barrel w/ bulkheads
- 28% less footprint with box sections
- No special stone backfill around boxes
- Low cover limits – in parking lot